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Visible and NIR emission detection of sensitized lanthanides

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1. 背景と研究目的

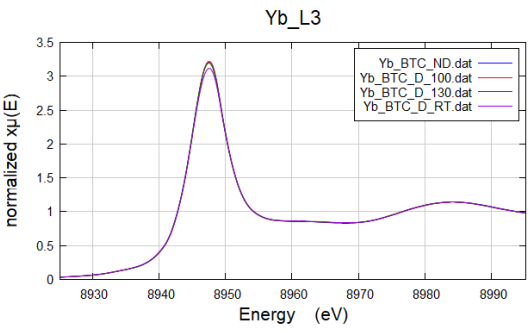
Dye sensitized lanthanides are an active area of research because it is an efficient way to circumvent the low absorption coefficients of these ions. For instance, the emission in the NIR is ideally applicable to telecommunication where Er, Yb, and Nd act as active materials in optical amplifiers of the NIR signals. In this case, we will study the structural changes and X-Ray Excitation Optical luminescence (XEOL) of Yb and Nd MOF with a dye included in the pores of the MOFs for lanthanide sensitization.

2. 実験内容

Nd and Yb-MOFs were impregnated with Eosin Y and treated at different temperatures. MOFs were mixed with BN in proportions according to get a jump equal to 1. The mixture of MOFs and BN was pressed to 10kN in a 7mm die. All samples: Ln-MOFs (ND), Ln-MOFs with dye without thermal treatment (D_{RT}), Ln-MOFs with dye treated at 100°C (D_{100}), and Ln-MOFs with dye treated at 130°C (D_{130}), where Ln = Nd, Yb were measured in Q-XAS, with measurements time of 2 minutes. The L_3 and L_1-edges of each lanthanide (Nd and Yb) were measured. XEOL measurements were performed using two spectrometers, one for the visible range and one for the NIR range.

3. 結果および考察

The L_1 and L_3 edges were successfully measured for Nd and Yb MOFs. Due to the low loading of dye, the study of the structural changes focuses on the XANES spectra instead of the EXAFS region. All the samples showed no relevant features in the pre-edge region. The L_3 edges showed intense white lines with respect to the L_1 edges. The intensity of the white lines showed differences in intensities for each lanthanide. In the case of Nd, the intensity of the L_3 lines was ND < D_{130} ≈ D_{RT} < D_{100} and for L_1 ND < D_{130} ≈ DRT ≈ D_{100}. In the case of Yb (see Figure), the intensity of the L_3 lines was D_{RT} < D_{130} < D_{100} ≈ ND, and for L_1 D_{130} ≈ D_{RT} ≈ ND < D_{100}. The tendency can be assumed similar in both edges, the L_3 edge exhibits a more intense white line which makes it easier to observe the differences. The changes in the white line intensity are explained by the changes in the coordination of the lanthanides as previously reported[1]. The difference in the white intensity order can be attributed to the position of Nd and Yb in the lanthanides groups, Nd corresponds to the light lanthanides group, while Yb to the heavy ones. The changes in the white line intensity indicates a coordination of the dye to the lanthanide, which evolves with thermal treatmanet.XEOL signal could not be collected from the samples even though the fluorescence was collected in the laboratory, the main problem was the spurious light in the NIR region which saturated the detector of the spectrometer.



4. 参考文献

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